# SHORT-RANGE WIRELESS AUDIO-VIDEO LINK FOR ACCIDENT & EMERGENCY MEDICINE

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*Abstract* - **In this paper, a wireless, simplex communication link covering a range of 100 ft (indoor) and up to 300 ft (outdoor) is presented. This link establishes a one channel color video and mono audio communication with an emergency vehicle such as an ambulance. To ensure a totally hands-free operation, a miniature camera is mounted on a modified safety helmet. The camera is fitted with a microphone. The video transmitter and supply battery are carried by a pouch tightened to the paramedical's waist. Field tests have shown that the system can reliably transmit audio and video signals from a simulated accident site to an emergency vehicle. Special emphasis has been put on using off-the-shelf available hardware components.**
**Keywords: Telemedicine, wireless, multimedia, accident and emergency**

## I. INTRODUCTION

In recent years, great amounts of research have been dedicated to telemedicine. Enabling technologies such as telecommunications, powerful processors and the Internet have all considerably contributed to this progress ([1] and [2]).
The aim of the present work is to implement the first phase of a teleconsultation project. In this system, an audio/video link has to be established between the accident site and the hospital. In many instances, during an accident, the site in which the patient is located is not accessible to vehicles. On the other hand, the wireless transmission of the audio/video and vital signals require processing capability and a considerable amount of power. Weight and size considerations make it very difficult for the paramedic to carry the devices necessary to this end together with the compulsory emergency kit to the site. Nonetheless the vehicle's battery will easily handle power supply requests to ensure processing by an on-board microcomputer and wireless transmission of signals from the site to the hospital. Therefore, there is a need to fill-in the gap between the accident site and the emergency vehicle.
In the proposed system, the paramedical has to carry a supplementary lightweight set consisting of the following items:

- Miniature camera
- Miniature microphone
- Video transmitter
- Power supply
- Convenient mean to carry the above, hands free

This set will allow the paramedic to wirelessly transmit the signals of interest to the ambulance. The increased mobility enables the paramedic to access difficult sites while a link remains active at all times between the accident site and the emergency vehicle. With the completion of the second segment, e.g. the wireless communication between the vehicle and the hospital, the paramedic (and therefore the patient) will constantly be in touch with a physician at the hospital. This feature can be essential in critical injuries or burns where special instructions need to be dispatched from the resident physician to the paramedic before the patient reaches the hospital.

## II. SYSTEM DESCRIPTION

The whole system, based on a previous design [3] consists of three modules in different geographical locations (Fig. 1):

- Extension (patient - mobile)
- Remote (vehicle - mobile)
- Physician (hospital - fixed)

In this paper, the development of the first module is only discussed. Details of the implementation are given.

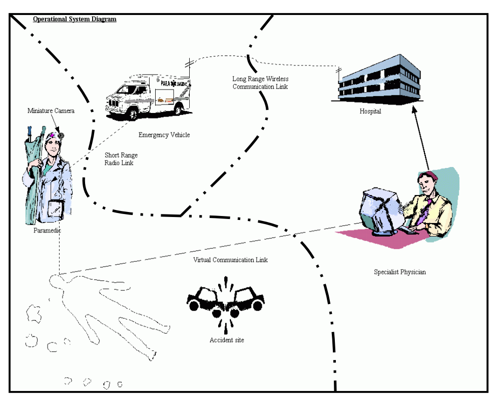


Fig. 1: System architecture

***The extension module*** consists of a helmet-mounted miniature video camera, an embedded microphone, a wireless transmitter and power supply.

The miniature camera (TAYAMA TC-5874-35A/M) has a ¼" CCD (charge coupled device) sensor with a resolution of 512

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**Abstract**

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x 582 pixels, color and offers a viewable resolution of 330 PAL television (TV) lines. An electronic shutter with an F3.6 mm lens ensures picture clarity under various light conditions. After various considerations as for the holding structure for the camera, it was decided that a safety helmet would offer a robust, adaptable, low-cost solution. A locally made safety helmet (ACE Polymers Sdn. Bhd.) has been specially adapted by making two holes, one for a screw to keep the camera in place, and the other for passing the video and audio cables. This particular helmet presented a flat surface approximately the size of the camera's footprint that was well suited to camera mounting. The small dimensions of the camera (36x36x15 $mm^3$) allow for a non-obtrusive mounting. The miniature camera consumes 130 mA of current under 12 VDC, the power supply being provided by the transmitter via a DC jack. The operational temperature range is from 0 $^oC$ to 50 $^oC$.
The output signals of the miniature camera, available through a BNC (for the video) and an RCA (for the audio) connectors, are fed to a transmitter (Vadar from Telesense Wirele's Pte Ltd). This wireless transmitter uses the Industrial-Scientific-Medical (ISM) band frequency band of 2.4 GHz. The RF bandwidth is 20 MHz and there is a possibility of selecting one out of the four available frequency bands. This feature avoids interference with near-by emitting stations. The radiated output power is 20 mW, while the transmitter itself consumes 130 mA under 12 VDC. The operational temperature range is from 0 $^oC$ to 50 $^oC$.
The selected battery is a 12 V, maintenance-free, sealed lead-acid (YUASA) with a capacity of 1.2 Ah. This capacity gives an operating time of about 4.5 hours between each charge. The weight of this battery is 0.57 kg.
The pouch is a simple travel pouch from Polyamide that has been selected with the appropriate dimensions so as to accommodate all the elements. The pouch comes with a standard belt that is tightened around the paramedic's waist. The whole set-up is represented in fig. 2.
Using this configuration, the paramedic will only have to wear the helmet and the pouch. The hands-free feature of the developed system allows performing his/her duties without too much physical interference from the system.

***The remote module*** consists of the wireless video receiver (Vadar) connected to a small TV set (MINAMI M-628C) in the ambulance (fig. 3). The size of the TV screen is 5 ¼". The receiver and TV are both powered by the 12 VDC available in the vehicle. To this end, the cigarette lighter plug is used. The TV consumes less than 15 W while the receiver draws 260 mA under 12 VDC. Once the connection has been checked, the TV can be turned off, reducing current drain from the vehicle's battery. The TV serves mostly for checking the signal integrity in the vehicle. In this way, before the stream of signals is retransmitted from the vehicle to the hospital, the emergency team can make sure that the signals are correctly received at the vehicle itself.

## III. RESULTS

The system was tested at the university campus using an ambulance from the student health center (fig. 4). The ambulance was stationed at the bottom of a hill-slope while the simulated accident happened at the upper side of the slope. The line of sight distance between the transmitter and the vehicle was about 50 m (150 ft). The quality of the reception was very good with video and audio being faithfully transmitted. However, when the paramedic moved, the colors of the picture seemed to be distorted for a while before getting back to normal after a few seconds. Total power consumption of the portable set (extension site consisting of the miniature camera, microphone and transmitter) was measured to be 260 mA under 12 VDC, while the total weight of the set was 1.670 kg.

## IV. CONCLUSION

The proposed system has established the first leg of a multi-segment teleconsultation system. One-way real-time video and audio is available between the accident site and the ambulance. Due to bandwidth limitations, only still-video communication will be established between the vehicle and the hospital.

The mobility and access to very difficult sites provided by deploying wireless communications is one of the main advantages of this system. Emphasis on utilizing off-the-shelf technologies has ensured cost-effectiveness and smooth integration. As the next step in this project, a wireless link between the emergency vehicle and the hospital is currently being developed.

Another possible area of application for this system is in the fire brigade where the fire fighters need to automatically relay vital information regarding the internal situation of a building to colleagues outside. To this end, an infrared camera could be used. Unmanned missions in hazardous environments could also benefit from this type of technology.

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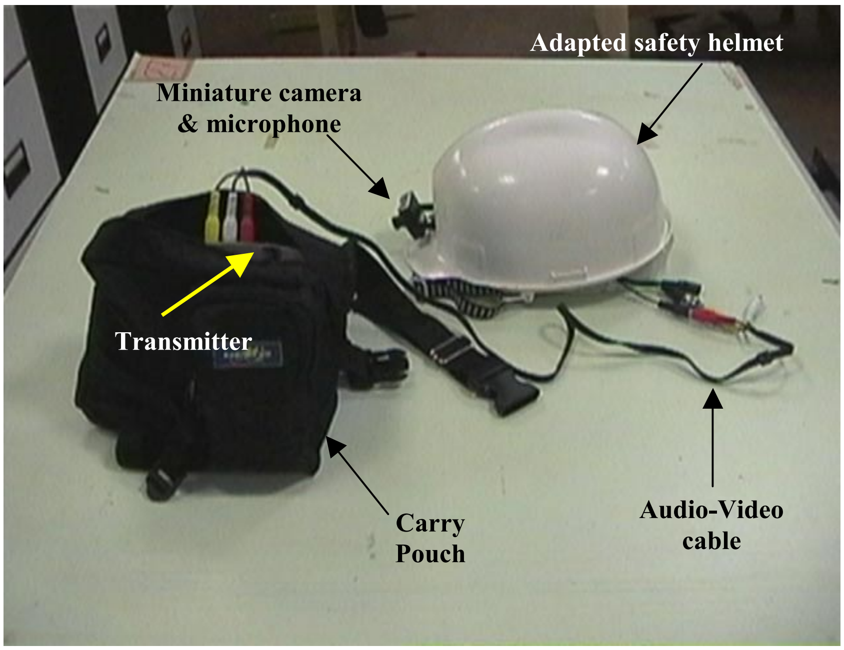


Fig. 2: Helmet-mounted miniature camera, cables, pouch containing transmitter and power supply (battery not visible)

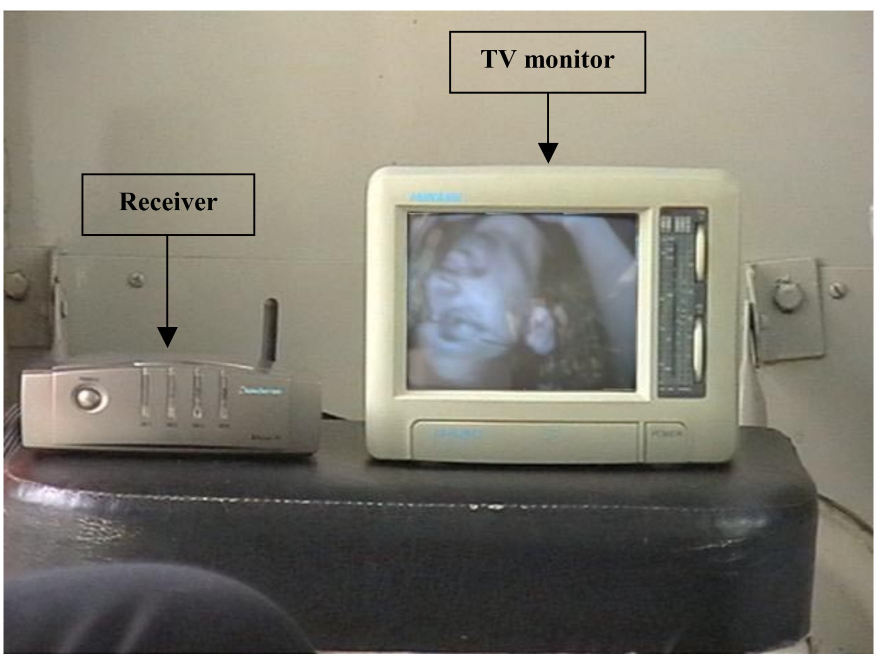


Fig. 3: ISM band (2.4 GHz) receiver with 12 VDC small television monitor set inside emergency

Fig. 4: Field trial consisting of the paramedic, ambulance and patient